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Identification and selection rules of the spin-wave eigenmodes in a normally magnetized nanopillar

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Abstract

We report on a spectroscopic study of the spin-wave eigenmodes inside an individual normally magnetized two-layer circular nanopillar (permalloy|copper|permalloy) by means of a magnetic resonance force microscope. We demonstrate that the observed spin-wave spectrum critically depends on the method of excitation. While the spatially uniform radio-frequency (rf) magnetic field excites only the axially symmetric modes having azimuthal index =0, the rf current flowing through the nanopillar, creating a circular rf Oersted field, excites only the modes having azimuthal index =+1. Breaking the axial symmetry of the nanopillar, either by tilting the bias magnetic field or by making the pillar shape elliptical, mixes different index symmetries, which can be excited simultaneously by the rf current. Experimental spectra are compared to theoretical prediction using both analytical and numerical calculations. An analysis of the influence of the static and dynamic dipolar coupling between the nanopillar magnetic layers on the mode spectrum is performed. © 2011 American Physical Society.

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